

Curriculum Vitae: David P. Edwards

National Center for Atmospheric Research

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EDUCATION

Van Mildert College, University of Durham, UK.

1983 B.Sc. (Honours) in Physics

Department of Physics, University of Birmingham, UK.

1984 M.Sc. The Physics and Technology of Nuclear Systems

Thesis title: "*Ion beam width effects on the growth of Rayleigh-Taylor instabilities in inertial confinement fusion targets*".

1987 Ph.D. Dense Plasma Physics Theory

Thesis title: "*Some theoretical studies on the implosion and fusion burn of heavy ion beam driven inertial confinement fusion targets*".

EMPLOYMENT & EXPERIENCE

Sep. 2013 National Center for Atmospheric Research (NCAR), Boulder, CO.

- Present **Interim Director, NCAR Earth System Laboratory (NESL)**

Associate Director, NCAR

Leading NESL in the scientific research areas of atmospheric chemistry, climate and global dynamics, microscale and mesoscale meteorology, and associated multidisciplinary activities. Serving as NCAR Associate Director and a member of the NCAR Executive Committee, sharing in management deliberations and offering advice on matters such as scientific goals, priorities, budgets, policies, programs, initiatives and standards. Shared responsibility for setting NCAR's future direction as a national center. Representing NESL to funding agencies, particularly the National Science Foundation, and the national and international scientific community.

Nov. 2011 National Center for Atmospheric Research, Boulder, CO.

- Aug. 2013 **Deputy Director, NCAR Earth System Laboratory (NESL)**

Leading in developing and implementing NESL mission and strategy, including program planning and development, and setting budget priorities. Fostering collaboration and coordinating activities among the NESL Divisions, with NCAR Laboratories, and the outside scientific community.

Mar. 2010 National Center for Atmospheric Research, Boulder, CO.

- May 2011 **NCAR Science Advisor**

Advising the NCAR Executive Committee on research and science issues across NCAR and communicating between the NCAR Executive Committee, the NCAR Directors' Committee and the NCAR Scientist Assembly. Full member of the NCAR Executive Committee.

Jul. 2007 - Present	National Center for Atmospheric Research, Boulder, CO. Senior Scientist & Section Head, Atmospheric Chemistry Division Program for Atmospheric Composition Remote Sensing & Prediction (ACRESP) Promoting the integration of satellite remote sensing data into state-of-the-art earth system models using data assimilation techniques and evaluating the ability of current and future satellite missions to meet science requirements. Research interests: Quantifying satellite instrument performance through Observation System Simulation Experiments and investigation of the role of remote sensing as a component of an integrated atmospheric composition prediction capability for chemical weather.
Jun. 2000 - Jun 2007	National Center for Atmospheric Research, Boulder, CO. Scientist III and Group Leader, Atmospheric Chemistry Division: NASA Co-Investigator and NCAR Group Leader for the Terra/MOPITT satellite project. Management responsibilities for data processing, algorithm enhancement, data validation exercises and coordinating science investigations. Research interests: Scientific utilization of tropospheric remote sensing data. Investigation of trace gas and aerosol seasonal variations and global distributions, sources and sinks. Emphasis on the role of biomass burning emissions, tropospheric transport of pollution, and resultant photochemistry.
Aug. 1991 - May 2000	National Center for Atmospheric Research, Boulder, CO. Scientist I and II, Atmospheric Chemistry Division Satellite instrument design research and algorithm development, data analysis, and scientific investigations with the NASA Earth Observing System (EOS), Upper Atmosphere Research Satellite (UARS), and ESA ENVISAT projects. Responsible for the development of operational retrieval radiative transfer models. Research interests: Atmospheric radiative transfer theory and modeling for planetary atmospheres; middle atmosphere non-local thermodynamic equilibrium (non-LTE) processes, chemistry and photochemistry; radiation balance; molecular spectroscopy.
Apr. 1992 - Apr. 1993	Instituto de Astrofísica de Andalucía, Granada, Spain. Scientific Visiting Fellowship: International collaboration to develop a non-LTE model to describe radiation processes in the middle atmosphere, and assess the implications for remote sensing and climate modeling.
Aug. 1989 - Jul. 1991	National Center for Atmospheric Research, Boulder, CO. Visiting Scientist: Work in the Global Atmospheric Change Group on satellite remote sounding of trace gases. Emphasis on spectral line shape considerations for satellite temperature sounding.

Jan. 1987	Hooke Institute for Atmospheric Research, Oxford University, UK.
- Jul. 1989	Post-Doctoral Research Fellow: Development of a new general atmospheric radiative transfer model, GENLN2.
Jun. 1986	Department of Physics, University of Birmingham, UK.
- Dec. 1986	Post-Doctoral Research Assistant: Projects arising from thesis work on the study of inertial confinement fusion, neutral and charged particle transport, and radiation processes in dense plasmas.

PRINCIPAL SCIENTIFIC ACCOMPLISHMENTS

Experience in the field of satellite remote sensing for atmospheric chemistry and dynamics includes contributions at every mission stage: science driven concept, instrument design, authoring science algorithms for data reduction, and scientific utilization of the measurements.

- Author of over 110 scientific papers in the peer-reviewed literature. Also technical reports, book chapters and proceedings. Regular presenter of invited talks and seminars at meetings and institutions worldwide.
- Developed a methodology using chemical observation system simulation experiments (OSSEs) to quantify just how useful a particular satellite observation is for answering a given science question. This involved the development of a simulator test-bed that allows a conceptual satellite instrument to “fly” through a model atmosphere, so producing simulated observations that could be evaluated using data assimilation tools. This research has application in helping decide the satellite instrumentation and observing strategies that will be most useful and cost effective for predicting chemical weather, and forms an important part of mission planning for the Geostationary Coastal and Air Pollution Events (GEO-CAPE) mission that observe air pollution over North and South America from geostationary orbit.
- Presented the first long-term global comparison of tropospheric carbon monoxide (CO) and aerosol optical depth measurements made by the Terra satellite. This work characterized seasonal variations of sources and sinks of these important pollutants, and identified significant inter-annual variability with the occurrence of sporadic wild fires.
- Investigated ways of combining data from several tropospheric remote sensing instruments to examine the global distributions of trace gases in the lower atmosphere, and how these impact tropospheric ozone chemistry. This new use of satellite data led to an explanation of the tropical Atlantic ozone “paradox” and a description of mechanisms leading to the observed regional distribution of ozone and precursors.
- Characterized the middle atmosphere radiation field and its dependence on solar, photochemical, and collisional molecular excitation mechanisms. Developed a scheme for describing radiative transfer under non-LTE conditions and identified CO₂, H₂O, O₃, and NO₂ non-LTE emissions in satellite measurements. This has resulted in a greater understanding of the middle atmosphere energetics affecting these molecules and the implications for climate modeling and satellite remote sensing of planetary atmospheres.

- Authored the state-of-the-art general line-by-line radiative transfer model GENLN2. This calculates atmospheric transmittance, radiance, flux, and cooling rates with full atmospheric radiative physics, including instrument effects. It is used widely in the community for the analysis of ground-based, aircraft and satellite spectroscopic measurements. It has applications in trace gas retrieval, radiative forcing studies, molecular spectroscopy, instrument design, reference calculations and coefficient generation for operational models. For many years, GENLN2 provided the radiative transfer basis for satellite data assimilation in the ECMWF and UK Met. Office operational forecast models. A new edition of this model, GENLN3, has recently been made available to the community.
- Advanced the understanding of both the CO₂ spectral line shape and the water vapor continuum. Presented some of the first observations of CO₂ spectral line mixing in atmospheric spectra, and then elaborated a model describing the resulting band profile and far-wing absorption. The importance of this led to its incorporation in the temperature retrieval schemes of the UARS IR sounders.
- Developed new, efficient and accurate approaches for fast radiative transfer modeling based on coefficient look-up, regression and correlated- k distribution techniques. These models have found application in operational retrieval codes and climate models.
- Contributed to defining the scientific and performance requirements of satellite IR remote sensing instruments. Selected the Aura/HIRDLS and Terra/MOPITT channel parameters to achieve optimal retrieval capability. Played a lead role in defining the operational scientific algorithm theoretical basis and design for MOPITT and HIRDLS. Contributed to UARS/CLAES temperature and trace gas data product validation studies.

PROFESSIONAL ACTIVITIES

NCAR Institutional Service

- NESL Directorate (Nov. 2011 – Present)
- NCAR Science Advisor (Mar. 2010 – May 2011)
- ACD Section Head (ACRESP) (Aug. 2008 – present)
- ACD Project Leader (MOPITT) (Jul. 2000 – Apr. 2010)
- NCAR Appointments Review Group (ARG) Investigative Subcommittees and Divisional Resource duties (multiple times)
- Group, Section and Divisional budget and strategic planning activities
- Chair, NCAR Earth System Lab. (NESL) committee on outside funding policy (2011)
- ACD Appointments Review Group
- Science Working Group for Earth System Science Lab. (ESSL) reorganization (2009)
- Writing Team for the NCAR Strategic Plan (2006)
- Coordinator for the new NCAR Remote Sensing Program (2005)

Scientific Community Service

- Regular reviewer of proposals for funding agencies
- Associate Editor (2000-2006) *J. Quantitative Spectroscopy & Radiative Transfer*
- Regular reviewer of manuscripts for journals *Appl. Opt.*, *JGR*, *ACP*, *GRL*...
- Regular reviewer of proposals to NSF, NASA, ESA
- Coordination of MOPITT operational processing of geophysical carbon monoxide products for free public distribution by NASA along with user education and support; promoting MOPITT-related science within the community (Jul. 2000 – Apr. 2010)
- Providing radiation models for international community use, particularly the GENLN2 code. Involves help to users in terms of problem definition and general support. GENLN2 is licensed by UCAR and has an international user group comprising government agencies, universities, and corporations, including NASA centers, UK. Met. O, & ECMWF (1992 – 2011)

Professional Meeting Organization

- **Organizer:** *Community Workshop on Air Quality Remote Sensing From Space: Defining an Optimum Observing Strategy*, NCAR, Boulder CO, Feb. 21–23, 2006
- **Co-Convenor:** *Joint IGAC/CACGP/WMO Symposium: Atmospheric Chemistry at the Interfaces*, Cape Town, South Africa, Sep. 17–23, 2006.
- **Co-Organizer:** *GEO-CAPE: Geostationary Coastal and Air Pollution Events Science Definition Planning Workshop*, University of North Carolina, Chapel Hill, NC, Aug. 18–20, 2008.
- **Co-Convenor:** *IGAC 10th International Conference, Bridging the scales in Atmospheric Chemistry: Local to Global*, Annecy, France, Sept. 7–12, 2008.
- **Co-Convenor:** *MOCA-09*, Montreal Canada, Jul. 19–29, 2009.
- **Organizer:** *Community Meeting on Data Assimilation in WRF-Chem: Application to Chemical Weather Studies*, NCAR, Boulder CO, Jan. 6–7, 2009.
- **Co-Convenor:** *IASI Science Conference*, Annecy, France, Jan. 25–29, 2010.
- **Co-Convenor:** *IGAC/iCACGP, Atmospheric Chemistry: Challenging the Future*, Halifax, Canada, Jul. 11–16, 2010.
- **Organizer:** *2nd GEO-CAPE Community Workshop*, NCAR, Boulder CO, May 11–13, 2011.
- **Co-Organizer:** *NASA Air Quality Applied Sciences Team (AQAST)*, NCAR, Boulder CO, May 14–15, 2011.
- **Co-Organizer:** *Atmospheric Composition Observation System Simulation Experiments (OSSE) Workshop*, ECMWF, Reading, UK, Oct. 22–24, 2012.
- **Co-Convenor:** *Application of Satellite Data to Serve Air Quality Management Needs*, American Geophysical Union, San Francisco CA, Dec. 3–7, 2012.
- **Co-Convenor:** *3rd IASI Conference*, Hyeres les Palmiers, France, Feb. 4–8, 2013.

- **Organizer:** 2013 GEO-CAPE Workshop, NASA Ames Research Center, Moffett Field, CA, May 21–22, 2013.
- **Organizer:** Geostationary Ocean Color and Air Quality Coordination Meeting, NASA Ames Research Center, Moffett Field, CA, May 23, 2013.

Committees & Working Groups

- WMO Global Atmospheric Watch (GAW) Expert Team on NRT Chemical Data (20011–present)
- Member of the UNECE Task Force on Hemispheric Transport of Air Pollution (HTAP): 2010 Report Author (2007–present)
- IUGG/IAMAS Commission on Atmospheric Chemistry and Global Change (CACGP) (2006–present)
- Co-Lead (with Daniel Jacob, Harvard): NASA GEO-CAPE mission Science Working Group (2010–present)
- Co-Chair (with Brad Pierce, NOAA): NASA GEO-CAPE mission Air Quality Standards and Processes group (2011–present)
- Co-Chair (with Arlindo Da Silva, NASA): NASA GEO-CAPE mission Global and Hemispheric OSSE group (2012–present)
- Member: NASA Air Quality Applied Science Team (2010–present)
- National Academies National Research Council Committee on the Significance of International Transport of Air Pollutants (ITAP) (2010)
- UNECE HTAP: Interim Report Coordinating Lead Author (2007)
- IUGG/IAMAS International Radiation Commission (IRC) subgroup on Remote Sounding of the Middle Atmosphere (RSMA) (2004–2008)
- Expert Panel for EUMETSAT MTG mission (2004)
- NASA ESSP-3 Selection Committee (2001)

- Co-Investigator for NASA Terra/MOPITT satellite instrument (1999–present)
- Co-Investigator for NASA EV-I/TEMPO satellite instrument (2012–present)
- Science team for NASA Aura/HIRDLS satellite instrument (2000–present)
- Science team for Korean GEMS geostationary satellite instrument (2010–present)
- Science team for European Monitoring of the Atmosphere from Geostationary orbit for European Air Quality (MAGEAQ) project (2010–present)
- Scientific Committee & Sounding Science Working Group (ISSWG-2) for the ESA/EUMETSAT METOP/IASI instrument (2009–present)
- Science team for NASA UARS/CLAES satellite instrument (1994–1998)
- Science team for ESA ENVISAT/MIPAS satellite instrument (1998–2004)
- Science team for SS/CRISTA satellite instrument (1998–2002)

Education & Outreach

- Interviews for radio, print and electronic media
- Scientific outreach for the MOPITT project
- Story production for NASA's *Earth Observer* website
- Regular contributor of science articles for *NCAR Staff Notes* and other publicity
- Educational animation production with the American Museum of Natural History (2006)
- Ph.D. thesis committee member, Univ. of Granada, Spain: Guillermo Zaragoza (1994)
- Ph.D. thesis committee member, Univ. of Granada, Spain: Francisco Javier Martin (1999)
- Ph.D. thesis committee member, Univ. of Granada, Spain: Cristina Roldan (2000)
- Ph.D. thesis committee member, Univ. of Granada, Spain: Sergio Gil (2006)
- Ph.D. Co-supervisor for R. Drori, Hebrew University of Jerusalem, Israel (2013)
- French Habilitation Degree Examiner member: Cathy Clerbaux, Paris, France (2006)
- French Habilitation Degree Examiner member: Jean-Luc Attie, Toulouse, France (2008)

Societies

- Member of the UK Institute of Physics
- Fellow of the UK Royal Meteorological Society
- Member of the American Geophysical Union
- Member of the American Meteorological Society

Awards & Recognition

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| Aug., 2013 | NASA Group Achievement Award for TEMPO |
| Aug., 2009 | NASA Group Achievement Award for ARCTAS |
| May, 2007 | NASA Group Achievement Award for Intercontinental Chemical Transport Experiment |
| Dec., 2006: | UCAR Outstanding Accomplishments Award for Scientific and Technical Advancement (for the MOPITT project) |
| Apr., 2006: | NASA Group Achievement Award for UARS Project |
| May, 2005: | NASA Group Achievement Award for Aura Project |
| Apr., 2005: | NASA Group Achievement Award for Intercontinental Chemical Transport Experiment North America Science Team |
| Mar., 2005: | NASA GSFC Group Achievement Award for Aura Team |
| Sep., 2004: | NASA GSFC Cert. of Recognition for Contributions to EOS Aura |
| 2003 & 2004: | Lead author on publication nominated for the UCAR Distinguished Achievement Award |
| Feb., 2003: | NASA Cert. of Appreciation for service to Earth Science Enterprise |

EXTERNALLY FUNDED COLLABORATIONS

- **Co-Investigator:** *Earth Venture (Instruments) TEMPO*, PI: Kelly Chance, Harvard SAO. NASA Earth Science Division, 2013–2018.
- **Principal Investigator:** *Atmospheric Composition and Air Quality Science Using Data From the European Metop Infrared Atmospheric Sounding Interferometer (IASI)*. NASA Earth Science Division, 2011–2015. \$750k.
- **Principal Investigator:** *Integrating carbon monoxide and aerosol retrievals: Improving estimates of aerosol vertical distribution, carbon component & local radiative forcing*, NASA Earth Science Division, 2011–2013. \$830k.
- **Principal Investigator:** *Air Quality Applied Sciences Team: Integrating satellite observations of tropospheric pollutants*. NASA Applied Sciences, 2011–2015. \$955k.
- **Principal Investigator:** *A Framework for Regional-Scale Atmospheric Composition Observation System & Simulation Experiments*. NASA Earth Science Division, 2011–2013. \$710k.
- **Principal Investigator:** *GEO-CAPE Preparatory Studies*, NASA Earth Science Division, 2011–2012. \$200k.
- **Co-Investigator:** *Tropospheric ozone and air quality in Australia*. PI: Clare Murphy, University of Wollongong, Australia. Australian Research Council, 2011–2013.
- **Co-Investigator:** *The Informational Gain of Satellite Products in Analyzing and Predicting Chemical Weather*. PI: Gabriele Pfister, NCAR. NASA Earth Science Division, 2010–2013.
- **Principal Investigator:** *GEO-CAPE Preparatory Studies*. NASA Earth Science Division, 2009–2011.
- **Co-Investigator:** *Chemical Forecasting and Analysis for ARCTAS using MOPITT measurements and the Community Atmosphere Model with Chemistry (CAM-Chem)*. PI: Louisa Emmons, NCAR. NASA Earth Science Division, 2008–2011.
- **Co-Investigator:** *Infrared Correlation Radiometer Fabrication and Characterization as Applied to the GEO-CAPE Decadal Survey Mission*, PI: Doreen Neil, NASA LaRC. Instrument Incubator - NASA Earth Science Division, 2008–2010.
- **Principal Investigator:** *Measurement Characterization Study for the Retrieval of Tropospheric Carbon Monoxide From Geo-Stationary Orbit*. NASA LaRC, 2007–2008.
- **Principal Investigator:** *Air Quality Remote Sensing From Space: Defining and Optimum Observing Strategy*. NASA Earth Science Division, 2005–2008.
- **Co-Investigator:** *An Intercomparison of Tropospheric Carbon Monoxide Measurements from the Past and Current Satellite Instruments: Using a Uniform Retrieval Algorithm*, PI: Juying Warner, UMBC. NASA Earth Science Division, 2005–2008.
- **Principal Investigator:** *Measurement Characterization Study for the Retrieval of Tropospheric Carbon Monoxide From Geo-Stationary Orbit*. NASA LaRC, 2006–2007.
- **Principal Investigator:** *TERRA/MOPITT Measurements of Tropospheric Carbon Monoxide and Data Analysis in Support of INTEX-NA*. NASA Earth Science Enterprise, 2005–2008.

- **Principle Investigator:** *Early Career Scientist and New Faculty Support for Attending the NCAR Community Workshop on Air Quality Remote Sensing From Space.* NSF, 2006.
- **Principle Investigator:** *Early Career Scientist and New Faculty Support for Attending the NCAR Community Workshop on Air Quality Remote Sensing From Space.* NASA Earth Science Enterprise, 2006.
- **Co-Investigator:** *Satellite and Ground-based Validation of TES Tropospheric CO Products,* PI: Ben Ho, NCAR. NASA Earth Science Enterprise, 2005–2008.
- **Principal Investigator:** *Measurement Characterization Study for the Retrieval of Tropospheric Carbon Monoxide From Geo-Stationary Orbit.* NASA LaRC, 2004–2005.
- **Co-Investigator:** *Using NASA Earth-Sun Science Products to Enhance a Comprehensive Air Quality Decision Support System in the Pacific Northwest,* PI: Brian Lamb, WSU. NASA Decision Support System, 2006–2009.
- **Co-Investigator:** *Biomass Burning Emissions: An Innovative Technique for Assessing Global Climate Impacts,* PI: Nicholas Jones, University of Wollongong, Australia. Australian Research Council, 2005–2008.
- **Principal Investigator:** *Terra/MOPITT Measurements of Tropospheric Carbon Monoxide in Support of INTEX.* NASA Earth Science Enterprise, 2004.
- **Co-Investigator:** *The Successor to Measurements Of Pollution In The Troposphere MOPITT-2,* PI: James R. Drummond, University of Toronto, Canada. Canadian Space Agency Advanced Studies Contract, 2003–2007.
- **Principal Investigator:** *Using Satellite Tropospheric Trace Gas Remote Sensing to Link Chemistry and Transport Between the Local and Global Scales.* NASA Earth Science Enterprise, 2003–2007.
- **Co-Investigator:** *Team Leader Proposal for the Measurement of Pollution in the Troposphere (MOPITT) Experiment,* PI: John Gille, NCAR. NASA Earth Science Enterprise, 2004–2007.
- **Co-Investigator:** *European ICARTT Data Management,* PI: Cathy Law, Universite Pierre et Marie Curie, France. CNRS, 2004.
- **Co-Investigator:** *Closing the Carbon Monoxide Budget: Variability in CO Emissions,* PI: Louisa Emmons, NCAR. NASA Earth Science Enterprise, 2004–2007.
- Visiting Professor, l'Observatoire Midi-Pyrénées de Toulouse, France, Nov. 2001.
- **Principal Investigator:** *NASA/UARS Special Investigator, Development of a UARS/CLAES mode 3 data product and its scientific utilization.* NASA Mission To Planet Earth, 1997–2000.
- Science Manager: *Reference forward model for the ESA/MIPAS instrument,* PI: C. D. Rodgers, Oxford University, UK. European Space Agency, 1996.
- Scientific Visiting Fellow: *Development of a non-LTE model for the Earth's atmosphere.* Instituto de Astrofísica de Andalucía, Scientific Research Council (CSIC), Spain, 1992.

Publications: David P. Edwards



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Section 1: Thesis

1. Edwards, D. P., *Ion beam width effects on the growth of Rayleigh-Taylor instabilities in inertial confinement fusion targets*, M.Sc. Thesis (1984), University of Birmingham, UK.
2. Edwards, D. P., *Some theoretical studies on the implosion and fusion burn of heavy ion beam driven inertial confinement fusion targets*, Ph.D. Thesis (1987), University of Birmingham, UK.

Section 2: Externally refereed journal articles

1. * Beynon, T. D. and D. P. Edwards (1986), On the effect of beam widths on the Rayleigh-Taylor instability of ion driven inertial confinement fusion targets, *J. Phys. D: Appl. Phys.*, **19**, 427–436.
2. Saunders, R. W., and D. P. Edwards (1989), Atmospheric transmittances for the AVHRR channels, *Appl. Opt.*, **28**, 4154–4160.
3. Edwards, D. P., and L. L. Strow (1991), Spectral line shape considerations for limb temperature sounders, *J. Geophys. Res.*, **96**, 20,859–20,868.
4. Kilsby, C. G., D. P. Edwards, R. W. Saunders, and J. S. Foot (1992), Water vapour continuum absorption in the tropics; aircraft measurements and model comparisons, *Q. J. R. Meteorol. Soc.*, **118**, 715–748.
5. López-Puertas, M., M. A. López-Valverde, D. P. Edwards, and F. W. Taylor (1993), Non-local thermodynamic equilibrium populations of the first vibrational excited state of CO in the middle atmosphere, *J. Geophys. Res.*, **98**, 8933–8947.
6. Edwards, D. P., M. López-Puertas, and M. A. López-Valverde (1993), Non-local thermodynamic equilibrium studies of the 15mm bands of CO₂ for atmospheric remote sensing, *J. Geophys. Res.*, **98**, 14,955–14,977.
7. Edwards, D. P., M. López-Puertas, and M. G. Mlynczak (1994), Non-local thermodynamic equilibrium radiance from O₃ and CO₂ in the 9–11-μm spectral region, *J. Quant. Spectrosc. Radiat. Transfer*, **52**, 389–407.
8. Pan, L., D. P. Edwards, J. C. Gille, and J. R. Drummond (1995), Satellite remote sensing of tropospheric CO and CH₄: forward model studies of the MOPITT instrument, *Appl. Opt.*, **34**, 6976–6988.
9. Edwards, D. P., J. C. Gille, P. L. Bailey, and J. J. Barnett (1995), Selection of sounding channels for the high resolution dynamics limb sounder (HIRDLS), *Appl. Opt.*, **34**, 7006–7018.
10. Gille, J. C., P. L. Bailey, S. T. Massie, L. V. Lyjak, D. P. Edwards, A. E. Roche, J. B. Kumer, J. L. Mergenthaler, M.R. Gross, A. Hauchecorne, P. Keckhut, T. J. McGee, I. S.

- McDermid, A. L. Miller, and U. Singh (1996), Accuracy and precision of Cryogenic Limb Array Etalon Spectrometer (CLAES) temperature retrievals, *J. Geophys. Res.*, **101**, 9583–9602.
11. Mergenthaler, J. L., J. B. Kumer, A. E. Roche, R. W. Nightingale, J. F. Potter, J. C. Gille, S. T. Massie, P. L. Bailey, D. P. Edwards, P. S. Connell, D. E. Kinnison, M. R. Gunson, M. C. Abrams, G. C. Toon, B. Sen, and J.-F. Blavier, D. G. Murcray, F. J. Murcray, and A. Goldman (1996), Validation of CLAES ClONO₂ measurements, *J. Geophys. Res.*, **101**, 9603–9620.
12. Roche, A. E., J. B. Kumer, R. W. Nightingale, J. L. Mergenthaler, G. A. Ely, P. L. Bailey, S. T. Massie, J. C. Gille, D. P. Edwards, M. R. Gunson, M. C. Abrams, G. C. Toon, C. R. Webster, W. A. Traub, K. W. Jucks, D. G. Johnson, D. G. Murcray, F. H. Murcray, A. Goldman, and E. C. Zipf (1996), Validation of CH₄ and N₂O measurements by the cryogenic limb array etalon spectrometer instrument on the Upper Atmosphere Research Satellite, *J. Geophys. Res.*, **101**, 9679–9710.
13. Nightingale, R. W., Roche, A. E., J. B. Kumer, J. L. Mergenthaler, J. C. Gille, S. T. Massie, P. L. Bailey, D. P. Edwards, M. R. Gunson, G. C. Toon, B. Sen, J.-F. Blavier and P. S. Connell (1996), Global CF₂Cl₂ measurements by UARS cryogenic limb array etalon spectrometer: Validation by correlative data and a model, *J. Geophys. Res.*, **101**, 9711–9736.
14. Bailey, P. L., D. P. Edwards, J. C. Gille, L. V. Lyjak, S. T. Massie, A. E. Roche, J. B. Kumer, J. L. Mergenthaler, B. J. Conner, M. R. Gunson, J. J. Margitan, I. S. McDermid, and T. J. McGee (1996), Comparison of cryogenic limb array etalon spectrometer (CLAES) O₃ observations with correlative measurements, *J. Geophys. Res.*, **101**, 9737–9756.
15. Massie, S. T., J. C. Gille, D. P. Edwards, P. L. Bailey, L. V. Lyjak, C. A. Craig, C. P. Cavanaugh, J. L. Mergenthaler, A. E. Roche, J. B. Kumer, A. Lambert, R. G. Grainger, C. D. Rodgers, F. W. Taylor, J. M. Russell, J. H. Park, T. Deshler, M. E. Hervig, E. F. Fishbein, J. W. Waters, and W. A. Lahoz (1996), Validation studies using multi-wavelength Cryogenic Limb Array Etalon Spectrometer (CLAES) observations of stratospheric aerosol, *J. Geophys. Res.*, **101**, 9757–9774.
16. Edwards, D. P., J. B. Kumer, M. López-Puertas, M. G. Mlynczak, A. Gopalan, J. C. Gille, and A. Roche (1996), Non-local thermodynamic equilibrium limb radiance near 10-mm as measured by UARS/CLAES, *J. Geophys. Res.*, **101**, 26,577–26,588.
17. López-Puertas, M., A. Dudhia, M. G. Shepherd, and D. P. Edwards (1997), Evidence of non-LTE in the CO₂ 15-mm weak bands from ISAMS and WINDII observations, *Geophys. Res. Lett.*, **24**, 361–364.
18. López-Puertas, M., G. Zaragoza, M.-A. López-Valverde, F. J. Martín-Torres, G. M. Shved, R. O. Manuilova, A. A. Kutepov, O. Gusev, T. v. Clarmann, A. Linden, G. Stiller, A. Wegner, H. Oelhaf, D. P. Edwards, J.-M. Flaud (1998), Non-local thermodynamic equilibrium limb radiances for the MIPAS instrument on Envisat-1, *J. Quant. Spectrosc. Radiat. Transfer*, **59**, 377–403.

19. Edwards, D. P., M. López-Puertas, and R. R. Gamache (1998), The non-LTE correction to the vibrational component of the internal partition sum for atmospheric calculations, *J. Quant. Spectrosc. Radiat. Transfer*, *59*, 423–436.
20. L. S. Rothman, C. P. Rinsland, A. Goldman, S. T. Massie, D. P. Edwards, J. M. Flaud, A. Perrin, V. Dana, J. Y. Mandin, J. Schroeder, A. McCann, R. R. Gamache, R. B. Wattson, K. Yoshino, K. V. Chance, K. W. Jucks, L. R. Brown, V. Nemtchinov, and P. Varanasi (1998), The HITRAN molecular spectroscopic database and HAWKS (HITRAN atmospheric workstation: 1996 edition, *J. Quant. Spectrosc. Radiat. Transfer*, *60*, 665–710.
21. López-Valverde, M. A., D. P. Edwards, M. López-Puertas, and C. Roldán (1998), Non-local thermodynamic equilibrium in general circulation models of the Martian atmosphere. Part 1. Effects of the local thermodynamic equilibrium approximation on thermal cooling and solar heating, *J. Geophys. Res. Planets*, *103*, 16,799–16,811.
22. Pan, L., J. C. Gille, D. P. Edwards, P. L. Bailey and C. D. Rodgers (1998), Retrieval of tropospheric carbon monoxide for the MOPITT experiment, *J. Geophys. Res.*, *103*, 32,277–32,290.
23. Edwards, D. P., C. Halvorson, and J. C. Gille (1999), Radiative transfer modeling for the EOS Terra Satellite Measurement of Pollution in the Troposphere (MOPITT) instrument, *J. Geophys. Res.*, *104*, 16,755–16,775.
24. Wang, J., J. C. Gille, P. L. Bailey, L. Pan, D. P. Edwards, and J. R. Drummond (1999), Retrieval of tropospheric carbon monoxide profiles from high resolution interferometer observations: A new digital gas correlation (DGC) method and applications, *J. Atmos. Sci.*, *56*, 219–232.
25. Roldán, C., M. A. López-Valverde, M. López-Puertas and D. P. Edwards (2000), Non-LTE infrared emissions of CO₂ in the atmosphere of Venus, *Icarus*, *147*, 11–25.
26. Edwards, D. P., and G. L. Francis (2000), Improvements to the correlated-*k* radiative transfer method: Application to infrared remote sounding, *J. Geophys. Res.*, *105*, 18,135–18,156.
27. Brage, T., P. G. Judge, P. Jonson, and D. P. Edwards (2000), Spectral lines for polarized measurements of the coronal magnetic field. III. Atomic data for SI IX, *Astrophys. J.*, *540*, 1114–1118.
28. Edwards, D. P., G. Zaragoza, M. Riese, and M. López-Puertas (2000), Evidence of H₂O nonlocal thermodynamic equilibrium emission near 6.4 μm as measured by cryogenic infrared spectrometers and telescopes for the atmosphere (CRISTA 1), *J. Geophys. Res.*, *105*, 29,003–29,021.
29. Warner, J., J. C. Gille, D. P. Edwards, D. C. Ziskin, M. W. Smith, P. L. Bailey, L. Rokke (2001), Cloud detection and clearing for the Earth Observing System Terra satellite Measurements of Pollution in the Troposphere (MOPITT) experiment, *Appl. Opt.*, *40*, 1269–1284.
30. Clerbaux, C., J. Hadji-Lazaro, S. Payan, C. Camy-Peyret, J. Wang, D. P. Edwards, and M. Luo (2002), Retrieval of CO from nadir remote-sensing measurements in the infrared using four different inversion algorithms, *Appl. Opt.*, *41*, 7068–7078.

31. Deeter, M. N., G. L. Francis, D. P. Edwards, J. C. Gille, E. McKernan, and J. R. Drummond (2002), Operational validation of the MOPITT instrument optical filters, *J. Atmos. Oceanic Tech.*, 19, 1772–1782.
32. v. Clarmann, T., A. Dudhia, D. P. Edwards, B. Funke, M. Hopfner, B. Kerridge, V. Kostsov, A. Linden, M. López-Puertas, and Y. Timofeyev (2002), Intercomparison of radiative codes under non-local thermodynamic equilibrium conditions, *J. Geophys. Res.*, 107, 4631, doi:10.1029/2001JD001551.
33. Collins, W. D., J. K. Hackney, and D. P. Edwards (2002), An updated parameterization for infrared emission and absorption by water vapor in the National Center for Atmospheric Research Community Atmosphere Model, *J. Geophys. Res.*, 107, 4664, doi:10.1029/2001JD001365.
34. Edwards, D. P., J.-F. Lamarque, J. -L. Attié, L. K. Emmons, A. Richter, J.-P. Cammas, J. C. Gille, G. L. Francis, M. N. Deeter, J. Warner, D. Ziskin, L. V. Lyjak, J. R. Drummond, and J. P. Burrows (2003), Tropospheric ozone over the tropical Atlantic: A satellite perspective, *J. Geophys. Res.*, 108, 4237, doi:10.1029/2002JD002927.
35. Lamarque, J.-F., D. P. Edwards, L. K. Emmons, J. C. Gille, O. Wilhelmi, C. Gerbig, D. Prevedel, M. N. Deeter, J. Warner, D. C. Ziskin, B. Khattatov, G. L. Francis, V. Yudin, S. Ho, D. Mao, J. Chen, and J. R. Drummond (2003), Identification of CO plumes from MOPITT data: Application to the August 2000 Idaho-Montana forest fires, *Geophys. Res. Lett.*, 30, 1688, doi:10.1029/2003GL017503.
36. Deeter, M. N., L. K. Emmons, G. L. Francis, D. P. Edwards, J. C. Gille, J. X. Warner, B. Khattatov, D. Ziskin, J.-F. Lamarque, S.-P. Ho, V. Yudin, J.-L. Attié, D. Packman, J. Chen, D. Mao, and J. R. Drummond (2003), Operational carbon monoxide retrieval algorithm and selected results for the MOPITT instrument, *J. Geophys. Res.*, 108, 4399, doi:10.1029/2002JD003186.
37. Heald, C. L., D. J. Jacob, A. M. Fiore, L. K. Emmons, J. C. Gille, M. N. Deeter, J. Warner, D. P. Edwards, J. H. Crawford, A. J. Hamlin, G. W. Sachse, E. V. Browell, M. A. Avery, S. A. Vay, D. J. Westberg, D. R. Blake, H. B. Singh, S. T. Sandholm, R. W. Talbot, and H. E. Fuelberg (2003), Asian outflow and trans-Pacific transport of carbon monoxide and ozone pollution: An integrated satellite, aircraft and model perspective, *J. Geophys. Res.*, 108(D24), 4804, doi:10.1029/2003JD003507.
38. Deeter, M. N., L. K. Emmons, G. L. Francis, D. P. Edwards, J. C. Gille, J. X. Warner, B. Khattatov, D. Ziskin, J.-F. Lamarque, S.-P. Ho, V. Yudin, J.-L. Attié, D. Packman, J. Chen, D. Mao, J. R. Drummond, P. Novelli, G. Sachse (2004), Evaluation of operational radiances for the Measurements of Pollution in the Troposphere (MOPITT) instrument CO thermal band channels, *J. Geophys. Res.*, 109, D03308, doi:10.1029/2003JD003970.
39. Emmons, L. K., M. N. Deeter, J. C. Gille, D. P. Edwards, J.-L. Attié, J. Warner, D. Ziskin, G. Francis, B. Khattatov, V. Yudin, J.-F. Lamarque, S.-P. Ho, D. Mao, J. S. Chen, J. Drummond, P. Novelli, G. Sachse, M. T. Coffey, J. W. Hannigan, C. Gerbig, S. Kawakami, Y. Kondo, N. Takegawa, H. Schlager, J. Baehr, H. Ziereis (2004), Validation of Measurements of Pollution in the Troposphere (MOPITT) CO retrievals with aircraft in situ profiles, *J. Geophys. Res.*, 109, D03309, doi:10.1029/2003JD004101.

40. Clerbaux, C., J. Gille, D. Edwards (2004), New directions: Infrared measurements of atmospheric pollution from space, *Atmos. Environ.*, **38**, 4599–4601.
41. Crawford, J. H., C. L. Heald, H. E. Fuelberg, D. M. Morse, G. W. Sachse, L. K. Emmons, J. C. Gille, D. P. Edwards, M. N. Deeter, G. Chen, J. R. Olson, V. S. Conners, C. Kittaka, and A. J. Hamlin (2004), Relationship between Measurements of Pollution in the Troposphere (MOPITT) and in situ observations of CO based on a large-scale feature sampled during TRACE-P, *J. Geophys. Res.*, **109**, D15S04, doi:10.1029/2003JD004308.
42. Lamarque, J.-F., B. Khattatov, V. Yudin, D. P. Edwards, J. C. Gille, L. K. Emmons, M. N. Deeter, J. Warner, D. C. Ziskin, G. L. Francis, S. Ho, D. Mao, and J. R. Drummond (2004), Application of a bias estimator for the improved assimilation of Measurements of Pollution in the Troposphere (MOPITT) carbon monoxide retrievals, *J. Geophys. Res.*, **109**, No. D16, D16304, doi:10.1029/2003JD004466.
43. Niu, J., M. N. Deeter, J. C. Gille, D. P. Edwards, D. C. Ziskin, G. L. Francis, A. J. Hills, and M. W. Smith (2004), Carbon Monoxide Total Column Retrievals by Use of the Measurements of Pollution in the Troposphere Airborne Test Radiometer, *Appl. Opt.*, **43**, 24, 4685–4696.
44. Deeter, M. N., L. K. Emmons, D. P. Edwards, J. C. Gille, and J. R. Drummond (2004), Vertical resolution and information content of CO profiles retrieved by MOPITT, *Geophys. Res. Lett.*, **31**, L15112, doi:10.1029/2004GL020235.
45. Pfister G., G. Pétron, L. K. Emmons, J. C. Gille, D. P. Edwards, J.-F. Lamarque, J.-L. Attié, C. Granier, P. C. Novelli (2004) Evaluation of CO simulations and the analysis of the CO budget for Europe, *J. Geophys. Res.*, **109**, D19304, doi:10.1029/2004JD004691.
46. Gros V., J. Williams, M. G. Lawrence, R. von Kuhlmann, J. van Aardenne, E. Atlas, A. Chuck, D. P. Edwards, V. Stroud, M. Krol (2004), Tracing the origin and ages of interlaced atmospheric pollution events over the tropical Atlantic Ocean with in situ measurements, satellites, trajectories, emission inventories, and global models, *J. Geophys. Res.*, **109**, D22306, doi:10.1029/2004JD004846.
47. Edwards, D. P., L. K. Emmons, D. A. Hauglustaine, A. Chu, J. C. Gille, Y. J. Kaufman, G. Pétron, L. N. Yurganov, L. Giglio, M. N. Deeter, V. Yudin, D. C. Ziskin, J. Warner, J.-F. Lamarque, G. L. Francis, S. P. Ho, D. Mao, J. Chan, and J. R. Drummond (2004), Observations of Carbon Monoxide and Aerosol From the Terra Satellite: Northern Hemisphere Variability, *J. Geophys. Res.*, **109**, D24202, doi:10.1029/2004JD0047272004.
48. Yudin, V., G. Pétron, J.-F. Lamarque, B. V. Khattatov, P. G. Hess, L. V. Lyjak, J. C. Gille, D. P. Edwards, M. N. Deeter, and L. K. Emmons (2004), Assimilation of the 2000–2001 CO MOPITT retrievals with optimized surface emissions, *Geophys. Res. Lett.*, **31**, L20105, doi:10.1029/2004GL021037.
49. Pétron, G., C. Granier, B. Khattatov, V. Yudin, J. Lamarque, L. Emmons, J. Gille, and D. P. Edwards (2004), Monthly CO surface sources inventory based on the 2000–2001 MOPITT satellite data, *Geophys. Res. Lett.*, **31**, L21107, doi:10.1029/2004GL020560.

50. Kar, J., H. Bremer, J. R. Drummond, Y. J. Rochon, D. B. A. Jones, F. Nichitiu, J. Zou, J. Liu, J. C. Gille, D. P. Edwards, M. N. Deeter, G. Francis, D. Ziskin, J. Warner (2004), Evidence of vertical transport of carbon monoxide from Measurements of Pollution in the Troposphere (MOPITT), *Geophys. Res. Lett.*, 31, L23105, doi:10.1029/2004GL021128.
51. Yurganov, L. N., P. Duchatelet, A. V. Dzhola, D. P. Edwards, F. Hase, I. Kramer, E. Mahieu, J. Mellqvist, J. Notholt, P. C. Novelli, A. Rockmann, H. E. Scheel, M. Schneider, A. Schulz, A. Strandberg, R. Sussmann, H. Tanimoto, V. Velazco, J. R. Drummond, J. C. Gille (2005), Increased Northern Hemispheric carbon monoxide burden in the troposphere in 2002 and 2003 detected from the ground and from space, *Atm. Chem. and Phys.*, 5, 563–573.
52. Tie X., S. Madronich, S. Walters, D. P. Edwards, P. Ginoux, N. Mahowald, R. Zhang, C. Lou, G. Brasseur (2005), Assessment of the global impact of aerosols on tropospheric oxidants, *J. Geophys. Res.*, 110, D03204, doi:10.1029/2004JD005359.
53. Pfister, G., J. C. Gille, D. Ziskin, G. Francis, D. P. Edwards, M. N. Deeter, and E. Abbott (2005), Effects of a spectral surface reflectance on measurements of backscattered solar radiation: Application to the MOPITT methane retrieval, *J. Atmos. Oceanic Tech.*, 22, 566–574.
54. Pfister, G., P. G. Hess, L. K. Emmons, J.-F. Lamarque, C. Wiedinmyer, D. P. Edwards, G. Pétron, J. C. Gille, and G. W. Sachse (2005), Quantifying CO emissions from the 2004 Alaskan wildfires using MOPITT CO data, *Geophys. Res. Lett.*, 32, L11809, doi:10.1029 /2005GL022995.
55. Ho, S.-P., D. P. Edwards, J. C. Gille, J. Chen, D. Ziskin, G. L. Francis, M. N. Deeter, and J. R. Drummond (2005), Estimates of 4.7mm surface emissivity and their impact on the retrieval of tropospheric carbon monoxide by Measurements of Pollution in the Troposphere (MOPITT), *J. Geophys. Res.*, 110, D21308, doi:10.1029/2005JD005946.
56. Pradier, S., J. L. Attié, M. Chong, J. Escobar, V.-H. Peuch, J.-F. Lamarque, B. Khattatov, D. Edwards (2006), Evaluation of 2001 springtime CO transport over West Africa using MOPITT CO measurements assimilated in a global chemistry transport model, *Tellus*, 58B, 163–176.
57. Francis, G. L., D. P. Edwards, A. Lambert, C. M. Halvorson, J. M. Lee-Taylor, and J. C. Gille (2006), Forward modeling and radiative transfer for the NASA EOS-Aura High Resolution Dynamics Limb Sounder (HIRDLS) instrument, *J. Geophys. Res.*, 111, D13301, doi:10.1029/2005JD006270.
58. Edwards, D. P., L. K. Emmons, J. C. Gille, A. Chu, J.-L. Attié, L. Giglio, S. W. Wood, J. Haywood, M. N. Deeter, S. T. Massie, D. C. Ziskin, and J. R. Drummond (2006), Satellite Observed Pollution From Southern Hemisphere Biomass Burning, *J. Geophys. Res.*, 111, D14312, doi:10.1029/2005JD006655.
59. Edwards, D. P., G. A. Pétron, P. C. Novelli, L. K. Emmons, J. C. Gille, and J. R. Drummond (2006), Southern Hemisphere carbon monoxide interannual variability observed by Terra/Measurement of Pollution in the Troposphere (MOPITT), *J. Geophys. Res.*, 111, D16303, doi:10.1029/2006JD007079.

60. Collins, W. D., J. M. Lee-Taylor, D. P. Edwards, and G. L. Francis (2006), Effects of increased near-infrared absorption by water vapor on the climate system, *J. Geophys. Res.*, 111, D18109, doi:10.1029/2005JD006796.
61. Massie, S. T., J. C. Gille, D. P. Edwards, and S. Nandia (2006), Satellite observations of aerosol and CO over Mexico City, *Atm. Env. Res.*, 40, 31, 6019–6031.
62. Kar, J., D. B. A. Jones, H. Bremer, J. R. Drummond, F. Nicitiu, J. Zou, J. Liu, J. C. Gille, D. P. Edwards, M. N. Deeter (2006), Carbon monoxide (CO) maximum over the Zagros Mountains in the Middle East: Signature of mountain venting? *Geophys. Res. Lett.* 33, L15819, doi:10.1029/2006GL026231
63. DeSouza-Machado, S. G., L. L. Strow, S. E. Hannon, H. E. Motteler, M. López-Puertas, B. Funke, and D. P. Edwards (2007), Fast forward radiative transfer modeling of 4.3 & 9.56 mm nonlocal thermodynamic equilibrium effects for infrared temperature sounders, *Geophys. Res. Lett.*, 34, L01802, doi:10.1029/2006GL026684.
64. Emmons, L. K., G. G. Pfister, D. P. Edwards, J. C. Gille, G. Sachse, D. Blake, S. Wofsy, C. Gerbig, D. Matross, and P. Nédélec (2007), Measurements of Pollution in the Troposphere (MOPITT) validation exercises during summer 2004 field campaigns over North America, *J. Geophys. Res.*, 112, D12S02, doi:10.1029/2006JD007833.
65. Deeter, M. N., D. P. Edwards, J. C. Gille, and P. C. Novelli (2007), Retrievals of carbon monoxide profiles from MOPITT observations using log-normal a priori statistics, *J. Geophys. Res.*, 112, D11311, doi:10.1029/2006JD007999.
66. Arellano, A.F. Jr., Raeder, K., Anderson, J. L., Hess, P. G., Emmons, L. K., Edwards, D. P., Pfister, G. G., Campos, T. L., and Sachse, G. W. (2007), Evaluating model performance of an ensemble-based chemical data assimilation system during INTEX-B field mission, *Atmos. Chem. Phys.*, 7, 5695–5710.
67. Deeter, M. N., D. P. Edwards, J. C. Gille, and J. R. Drummond (2007), Sensitivity of MOPITT observations to carbon monoxide in the lower troposphere, *J. Geophys. Res.*, 112, D24306, doi:10.1029/2007JD008929.
68. Bousserez, N., et al. (2007), Evaluation of the MOCAGE chemistry transport model during the ICARTT/ITOP experiment, *J. Geophys. Res.*, 112, D10S42, doi:10.1029/2006JD007595.
69. Turquety, S., J. A. Logan, D. J. Jacob, R. C. Hudman, F. Y. Leung, C. L. Heald, R. M. Yantosca, S. Wu, L. K. Emmons, D. P. Edwards, G. W. Sachse (2007), Inventory of boreal fire emissions for North America in 2004: the importance of peat burning and pyro-convective injection, in press *J. Geophys. Res.* 112, D12S03, doi:10.1029/2006JD007281
70. Clerbaux, C., D. P. Edwards, L. Emmons, M. Deeter, J.-F. Lamarque, S. Massie, and J. Gille (2008), Carbon monoxide pollution from urban areas observed by the Terra/MOPITT mission, *Geophys. Res. Lett.* 35, L03817, doi:10.1029/2007GL032300.
71. Clerbaux, C., George, M., Turquety, S., Walker, K. A., Barret, B., Bernath, P., Boone, C., Borsdorff, T., Cammas, J. P., Catoire, V., Coffey, M., Coheur, P.-F., Deeter, M., De Mazière, M., Drummond, J., Duchatelet, P., Dupuy, E., de Zafra, R., Eddounia, F., Edwards, D. P., Emmons, L., Funke, B., Gille, J., Griffith, D. W. T., Hannigan, J., Hase,

- F., Höpfner, M., Jones, N., Kagawa, A., Kasai, Y., Kramer, I., Le Flochmoën, E., Livesey, N. J., López-Puertas, M., Luo, M., Mahieu, E., Murtagh, D., Nédélec, P., Pazmino, A., Pumphrey, H., Ricaud, P., Rinsland, C. P., Robert, C., Schneider, M., Senten, C., Stiller, G., Strandberg, A., Strong, K., Sussmann, R., Thouret, V., Urban, J., and Wiacek (2008), CO measurements from the ACE-FTS satellite instrument: data analysis and validation using ground-based, airborne and spaceborne observations, *Atmos. Chem. Phys.*, 8, 2569–2594.
72. Turquety, S., C. Clerbaux, K. Law, P.-F. Coheur, A. Cozic, S. Szopa, D. A. Hauglustaine, J. Hadji-Lazaro, A. M. S. Gloudemans, H. Schrijver, C. D. Boone, P. F. Bernath, and D. P. Edwards (2008), CO emission and export from Asia: an analysis combining complementary satellite measurements (MOPITT, SCIAMACHY and ACE-FTS) with global modeling, *Atmos. Chem. Phys.*, 8, 5187–5204.
73. Fishman, J., K. W. Bowman, J. P. Burrows, A. Richter, K. V Chance, D. P. Edwards, R. V. Martin, G. A. Morris, R. B. Pierce, J. R. Ziemke, J. A. Al-Saadi, J. K. Creilson, T. K. Schaack, A. M. Thompson (2008), Remote sensing of tropospheric pollution from Space, *BAMS* 89, 805–821.
74. Gille, J. C., J. J. Barnett, P. Arter, M. Barker, P. F. Bernath, C. D. Boone, C. Cavanaugh, J. Chow, M. T. Coffey, J. Craft, C. Craig, M. Dials, V. Dean, T. Eden, D. P. Edwards, G. Francis, C. Halvorson, V. L. Harvey, C. Hepplewhite, R. Khosravi, D. E. Kinnison, C. Krinsky, A. Lambert, H. Lee, L. V. Lyjak, J. Loh, W. G. Mankin, S. T. Massie, J. M. McInerney, J. Moorhouse, B. Nardi, D. Packman, C. E. Randall, J. Reburn, W. Rudolf, M. J. Schwartz, J. Serafin, K. Stone, B. Torpy, K. A. Walker, A. M. Waterfall, R. Watkins, J. Whitney, D. Woodard, and G. Young (2008), The High Resolution Dynamics Limb Sounder (HIRDLS): Experiment Overview, Recovery and Validation of Initial Temperature Data, *J. Geophys. Res.*, 113, D16S43, doi:10.1029/2007JD008824.
75. Malmberg, A., A. Arellano, D. P. Edwards, N. Flyer, D. Nychka, C. Wikle (2008), Interpolating fields of carbon monoxide data using a hybrid statistical-physical model, *Annals of Applied Statistics* 2, 1231–1248, DOI:10.1214/08-AOAS168.
76. Kar, J, D. B. A. Jones, J. R. Drummond, J. L. Attie', J. Liu, J. Zou, F. Nichitiu, M. D. Seymour, D. P. Edwards, M. N. Deeter, J. C. Gille, and A. Richter (2008), Measurement of Low Altitude CO over the Indian subcontinent by MOPITT, *J. Geophys. Res.*, 113, D16307, doi:10.1029/2007JD009362.
77. Deeter, M. N., D. P. Edwards, J. C. Gille, and J. R. Drummond (2009), CO retrievals based on MOPITT near-infrared observations, *J. Geophys. Res.*, 114, D04303, doi:10.1029/2008JD010872.
78. Emmons, L. K., D. P. Edwards, M. N. Deeter, J. C. Gille, T. Campos, P. Nédélec, P. Novelli, and G. Sachse (2009), Measurements of Pollution In The Troposphere (MOPITT) validation through 2006, *Atmos. Chem. Phys.*, 9, 1795–1803.
79. Imhoff, M. L. R. Wolfe, D. J. Diner, M. Chopping, R. Kahn, V. Salomonson, J. Gille, J. Drummond, D. Edwards, N. Loeb, B. Wielicki, M. Abrams, B. Eng, S.-C. Tsay and K. J. Ranson (2009), An Overview of Terra Mission Results Related to the Carbon Cycle, *Geography Compass* 3, 10.1111/j.1749-8198.2008.00183.x.

80. Khosravi, R., et al. (2009), Overview and Characterization of Retrievals of Temperature and Atmospheric Constituents from HIRDLS Measurements, *J. Geophys. Res.*, 114, D20304, doi:10.1029/2009JD011937.
81. Ho, S.-P., D. P. Edwards, J. C. Gille, M. Luo, G. B. Osterman, S. S. Kulawik, and H. Worden (2009), A global comparison of carbon monoxide profiles and column amounts from Tropospheric Emission Spectrometer (TES) and Measurements of Pollution in the Troposphere (MOPITT), *J. Geophys. Res.*, 114, D21307, doi:10.1029/2009JD012242.
82. Edwards, D. P., A. F. Arellano Jr., and M. N. Deeter (2009), A satellite observation system simulation experiment for carbon monoxide in the lowermost troposphere, *J. Geophys. Res.*, 114, D14304, doi:10.1029/2008JD011375.
83. George, M., C. Clerbaux, D. Hurtmans, S. Turquety, P.-F. Coheur, M. Pommier, J. Hadji-Lazaro, D. P. Edwards, H. Worden, M. Luo, C. Rinsland, and W. McMillan (2009), Carbon monoxide distributions from the IASI/METOP mission: evaluation with other space-borne remote sensors, *Atmos. Chem. Phys.*, 9, 8317–8330.
84. Pfister, G., L. Emmons, D. P. Edwards, A. Arellano, G. Sachse, and T. Campos (2010), Variability of springtime transpacific pollution transport during 2000–2006: the INTEX-B mission in the context of previous years, *Atmos. Chem. Phys.*, 10, 1345–1359.
85. Kopacz, M., D. J. Jacob, J. A. Fisher, J. A. Logan, L. Zhang, I. A. Megretskaya, R. M. Yantosca, K. Singh, D. K. Henze, J. P. Burrows, M. Buchwitz, I. Khlystova, W. W. McMillan, J. C. Gille, D. P. Edwards, A. Eldering, V. Thouret, and P. Nedelec (2010), Global estimates of CO sources with high resolution by adjoint inversion of multiple satellite datasets (MOPITT, AIRS, SCIAMACHY, TES), *Atmos. Chem. Phys.*, 10, 855–876.
86. Deeter, M. N., D. P. Edwards, J. C. Gille, L. K. Emmons, G. Francis, S.-P. Ho, D. Mao, D. Masters, H. Worden, J. R. Drummond, and P. C. Novelli (2010), The MOPITT version 4 CO product: Algorithm enhancements, validation, and long-term stability, *J. Geophys. Res.*, 115, D07306, doi:10.1029/2009JD013005.
87. Paton-Walsh, C., N. M. Deutscher, D. W. T. Griffith, B. W. Forgan, S. R. Wilson, N. B. Jones, and D. P. Edwards (2010), Trace Gas Emissions from Savanna Fires in Northern Australia, *J. Geophys. Res.*, 115, D16314, doi:10.1029/2009JD013309.
88. Arellano, A. F., Jr., P. G. Hess, D. P. Edwards, and D. Baumgardner (2010), Constraints on black carbon aerosol distribution from Measurement of Pollution in the Troposphere (MOPITT) CO, *Geophys. Res. Lett.*, 37, L17801, doi:10.1029/2010GL044416.
89. Worden, H. M., M. N. Deeter, D. P. Edwards, J. C. Gille, J. R. Drummond, and P. Nédélec (2010), Observations of near-surface carbon monoxide from space using MOPITT multispectral retrievals, *J. Geophys. Res.*, 115, D18314, doi:10.1029/2010JD014242.
90. Claeysman, M., J.-L. Attié L. El Amraoui, D. Cariolle, V.-H. Peuch, H. Teyssèdre, B. Josse, P. Ricaud, S. Massart, A. Piacentini, J.-P. Cammas, N. J. Livesey, H. C. Pumphrey, and D. P. Edwards (2010), A linear CO chemistry parameterization in a chemistry-transport model: evaluation and application to data assimilation, *Atmos. Chem. Phys.*, 10, 6097–6115.

91. Claeysman, M., J.-L. Attié, V.-H. Peuch, L. El Amraoui, W. A. Lahoz, B. Josse, M. Joly, J. Barré, P. Ricaud, S. Massart, A. Piacentini, T. von Clarmann, M. Höpfner, J. Orphal, J.-M. Flaud, and D. P. Edwards (2011), A thermal infrared instrument onboard a geostationary platform for CO and O₃ measurements in the lowermost troposphere: Observing System Simulation Experiments (OSSE), *Atmos. Meas. Tech.*, 4, 1637–1661, doi:10.5194/amt-4-1637-2011.
92. Pfister, G. G., D. Parrish, H. Worden, L. K. Emmons, D. P. Edwards, C. Wiedinmyer, G. S. Diskin, G. Huey, S. J. Oltmans, V. Thouret, A. Weinheimer, A. Wisthaler (2011), Characterizing Summertime chemical boundary conditions for airmasses entering the U.S. West Coast, *Atmos. Chem. Phys.* 11, 1769–1790.
93. Deeter, M. N., H. M. Worden, J. C. Gille, D. P. Edwards, D. Mao, and J. R. Drummond (2011), MOPITT multispectral CO retrievals: Origins and effects of geophysical radiance errors, *J. Geophys. Res.*, 116, D15303, doi:10.1029/2011JD015703
94. Phulpin, T., C. Camy-Peyret, J. Taylor, C. Clerbaux, P. Coheur, C. Crevoisier, D. Edwards, A. Gambacorta, V. Guidard, F. Hilton, N. Jacquinet, R. Knuteson, L. Lavanant, T. McNally, M. Matricardi, H. Revercomb, C. Serio, L. Strow, P. Schlussel, D. Klaes, C. Larigauderie (2011), Les résultats exceptionnels de la sonde atmosphérique hyperspectral de Metop, *La Météorologie*, 72, 19–30.
95. Pfister, G. G., J. Avise, C. Wiedinmyer, D. P. Edwards, L. K. Emmons, G. D. Diskin, J. Podolske, and A. Wisthaler (2011), CO source contribution analysis for California during ARCTAS-CARB, *Atmos. Chem. Phys.*, 11, 7515–7532, doi:10.5194/acp-11-7515-2011.
96. Illingworth, S. M., J. J. Remedios, H. Boesch, S.-P. Ho, D. P. Edwards, P. I. Palmer, and S. Gonzi (2011) A comparison of OEM CO retrievals from the IASI and MOPITT instruments, *Atmos. Meas. Tech.*, 4, 775–793, doi:10.5194/amt-4-775-2011.
97. Wespes, C., L. Emmons, D. P. Edwards, J. Hannigan, D. Hurtmans, M. Saunois, P.-F. Coheur, C. Clerbaux, M. T. Coffey, R. L. Batchelor, R. Lindenmaier, K. Strong, A. J. Weinheimer, J. B. Nowak, T. B. Ryerson, J. D. Crounse, and P. O. Wennberg (2012), Analysis of ozone and nitric acid in spring and summer Arctic pollution using aircraft, ground-based, satellite observations and MOZART-4 model: source attribution and partitioning, *Atmos. Chem. Phys.*, 12, 237–259, doi:10.5194/acp-12-237-2012.
98. Natraj, V., X. Liu, S. Kulawik, K. Chance, R. Chatfield, D. P. Edwards, A. Eldering, G. Francis, T. Kurosu, K. Pickering, R. Spurr and H. Worden (2012), Multispectral sensitivity studies for the retrieval of tropospheric and lowermost tropospheric ozone from simulated clear-sky GEO-CAPE measurements, *Atm. Env.* 45, 7151–7165.
99. Lahoz, W. A., V.-H. Peuch, J. Orphal, J.-L. Attie, K. Chance, X. Liu, D. P. Edwards, H. Elbern, J.-M. Flaud, M. Claeysman (2012), Monitoring Air Quality from Space: The Case for the Geostationary Platform, *Bull. Amer. Meteor. Soc.*, 93, 221–233.
100. Keywood, M., M. Kanakidou, A. Stohl, F. Dentener, G. Grassi, C. P. Meyer, K. Torseth, D. Edwards, A. M. Thompson, U. Lohmann and J. Burrows (2013), Fire in the Air – Biomass burning impacts in a changing climate, *Critical Rev. Env. Sci. Tech.*, 43:1, 40–83.

101. Drori, R., U. Dayan, D. P. Edwards, L. K. Emmons and C. Erlick (2012), Attributing and quantifying European carbon monoxide sources affecting the Eastern Mediterranean: A combined satellite, modelling, and synoptic analysis study, *Atmos. Chem. Phys.*, 12, 1067–1082.
102. Hilton, F., et al., (2012), Hyperspectral Earth Observation from IASI: Five Years of Accomplishments, *Bull. Amer. Meteor. Soc.*, 93, 347–370.
103. Fishman, J., L. T. Iraci, J. Al-Saadi, P. Bontempi, K. Chance, F. Chavez, M. Chin, P. Coble, C. Davis, P. DiGiacomo, D. Edwards, A. Eldering, J. Goes, J. Herman, C. Hu, D. Jacob, C. Jordan, S. R. Kawa, R. Key, X. Liu, S. Lohrenz, A. Mannino, V. Natraj, D. Neil, J. Neu, M. Newchurch, K. Pickering, J. Salisbury, H. Sosik, A Subramaniam, M. Tzortziou, J. Wang, M. Wang (2012), The United States' Next Generation of Atmospheric Composition and Coastal Ecosystem Measurements: NASA's Geostationary Coastal and Air Pollution Events (GEO-CAPE) Mission, *Bull. Amer. Meteor. Soc.*, 93 (10), 1548–1566.
104. Boynard, A., G. G. Pfister, and D. P. Edwards (2012), Boundary layer versus free tropospheric CO budget and variability over the United States during summertime, *J. Geophys. Res.*, 117, D04306, doi:10.1029/2011JD016416.
105. Deeter, M. N., H. M. Worden, D. P. Edwards, J. C. Gille, and A. E. Andrews (2012), Evaluation of MOPITT retrievals of lower-tropospheric carbon monoxide over the United States, *J. Geophys. Res.*, 117, D13306, doi:10.1029/2012JD017553.
106. Worden, H. M., Y. Cheng, G. Pfister, G. R. Carmichael, Q. Zhang, D. G. Streets, M. Deeter, D. P. Edwards, J. C. Gille, and J. R. Worden (2012), Satellite based estimates of reduced CO and CO₂ emissions due to traffic restrictions during the 2008 Beijing Olympics, *Geophys. Res. Lett.*, 39, L14802, doi:10.1029/2012GL052395.
107. Worden, H. M., M. N. Deeter, C. Frankenberg, M. George, F. Nichitiu, J. Worden, I. Aben, K. W. Bowman, C. Clerbaux, P. F. Coheur, A. T. J. de Laat, R. Detweiler, J. R. Drummond, D. P. Edwards, J. C. Gille, D. Hurtmans, M. Luo, S. Martínez-Alonso, S. Massie, G. Pfister, and J. X. Warner (2013), Decadal record of satellite carbon monoxide observations, *Atmos. Chem. Phys.*, 13, 837-850, doi:10.5194/acp-13-837-2013.
108. Deeter, M. N., S. Martínez-Alonso, D. P. Edwards, L. K. Emmons, J. C. Gille, H. M. Worden, J. V. Pittman, B. C. Daube and S. C. Wofsy (2013), Validation of MOPITT Version 5 thermal-infrared, near-infrared, and multispectral carbon monoxide profile retrievals for 2000–2011, *J. Geophys. Res. Atmos.*, 118, doi:[10.1002/grd.50272](https://doi.org/10.1002/grd.50272).
109. Streets, D. G., T. Canty, G. R. Carmichael, B. de Foy, R. R. Dickerson, B. N. Duncan, D. P. Edwards, J. A. Haynes, D. K. Henze, M. R. Houyoux, D. J. Jacob, N. A. Krotkov, L. N. Lamsal, Y. Liu, Z. Lu, R. V. Martin, G. G. Pfister, R. W. Pinder, R. J. Salawitch, and K. J. Wecht (2013), Emissions estimation from satellite retrievals: A review of current capability, *Atm. Env.* 77, 1011–1042.

110. Worden, H. M., D. P. Edwards, M. N. Deeter, D. Fu, S. S. Kulawik, J. R. Worden, and A. Arellano (2013), Averaging kernel prediction from atmospheric and surface state parameters based on multiple regression for nadir-viewing satellite measurements of carbon monoxide and ozone, *Atmos. Meas. Tech.*, 6, 1633–1646
111. Sellitto, P., G. Dufour, M. Eremenko, L. Cuesta, V.-H. Peuch, A. Eldering, D. P. Edwards, and J.-M. Flaud (2013), The effect of using limited scene-dependent averaging kernels approximations for the implementation of fast observing system simulation experiments targeted on lower tropospheric ozone, *Atmos. Meas. Tech.*, 6, 1869–1881, doi:10.5194/amt-6-1869-2013.
112. Worden, H. M., M. N. Deeter, D. P. Edwards, J. Gille, J. Drummond, L. K. Emmons, G. Francis, S. Martínez-Alonso (2013), 13 Years of MOPITT Operations: Lessons from MOPITT Retrieval Algorithm Development, *Ann. Geophys.*, 56, 10.4401/ag-6330
113. Zoogman, P., D. J. Jacob, K. Chance, H. M. Worden, D. P. Edwards and L. Zhang, Improved monitoring of surface ozone by joint assimilation of geostationary satellite observations of ozone and CO (2014), *Atm. Env.* 84, 254–261.
114. Worden, H. M., M. N. Deeter, D. P. Edwards, J. Gille, J. Drummond, L. K. Emmons, G. Francis, S. Martínez-Alonso (2014), 13 years of MOPITT operations: lessons from MOPITT retrieval algorithm development, *Annals of Geophysics* 56, doi:10.4401/ag-6330.

Section 3: Other external refereed publications

1. Edwards, D. P. (1987), GENLN2: The new Oxford line-by-line atmospheric transmission/radiance model, Dept. of Atmospheric, Oceanic and Planetary Physics, *Memorandum 87.2*, University of Oxford, UK.
2. Edwards, D. P. (1988), Atmospheric transmittance and radiance calculations using line-by-line computer models, **Invited review**, *SPIE Modeling of the Atmosphere*, 928, 94–116.
3. Fishman, J., D. Neil, J. Crawford, R. B. Pierce, D. Edwards, K. Chance, T. Kurosu, W. P. Menzel, G. Foley, R. Scheffe, Earth's First Time Resolved Mapping of Air Pollution Emissions and Transport from Space, Submission to the NRC Decadal Study Earth Science and Applications from Space, May 2005.
4. Edwards, D. P. (2006), Air quality remote sensing from space, *Eos, Trans. AGU*, 87 (33), 327.
5. Edwards, D. P., NCAR Workshop on Air Quality Remote Sensing From Space: Defining an Optimum Observing Strategy, *The Earth Observer*, 18 (3), 18–19, NASA, 2006.
6. *Atmospheric Pollution: A Global Problem in Our Changing Planet: The View from Space*, Chapter Author, Cambridge University Press, 2007.
7. *Hemispheric Transport of Air Pollution 2007*, *Air Pollution Studies No. 16*, (2007) Coordinating Lead Author for *Chapter 3: Observational evidence and capabilities*, United Nations.

8. *Hemispheric Transport of Air Pollution 2010, Air Pollution Studies No. 17*, (2010) Co-Author for Part A, Chapter 2: *Observational evidence and capabilities related to intercontinental transport of ozone and particulate matter*, United Nations.
9. *Global Sources of Local Pollution*, Committee on the significance of international transport of air pollutants, Co-Author, NRC, National Academies of Science, 2010.

Section 4: Publications submitted or in preparation

1. Edwards, D. P., L. K. Emmons, N. Jones, C. Murphy, N. Deutscher, R. Bucholz, and D. Griffith, Satellite and ground-based remote sensing of Carbon Monoxide over Australasia: Linking global and local scales, in preparation for submission to *J. Geophys. Res.*, (2013).
2. Pfister, G., S. Walters, L. K. Emmons, D. P. Edwards, J. Avise, Quantifying the contribution of inflow on surface ozone over California, submitted to *J. Geophys. Res.*, (2013).
3. Arellano, A. F. and D. P. Edwards: Assimilating correlated profile retrievals of chemical constituents in the troposphere, in preparation for submission to *J. Geophys. Res.*, (2013).

Section 5: Internally refereed publications

1. Edwards, D. P. (1992), GENLN2: A general line-by-line atmospheric transmittance and radiance model, Version 3.0 description and users guide, *NCAR/TN-367-STR*, National Center for Atmospheric Research, Boulder, Co.
2. Edwards, D. P. (1996), Development of a reference forward algorithm for MIPAS passive atmospheric sounding, *ESTEC PO-TN-OXF-GS-0004*, University of Oxford, UK.
3. Judge, P. G., R. Casini, S. Tomczyk, D. P. Edwards, G. Francis (2000), Coronal magnetometry: A feasibility study, *NCAR/TN-466+STR*, National Center for Atmospheric Research, Boulder, Co.
4. Massie, S. T., Edwards, D. P., and J. C. Gille, UARS CLAES Mode 3 spectral archive, in preparation *NCAR Technical Note*, National Center for Atmospheric Research, Boulder, CO.
5. Edwards, D., W. Collins and D. Schimel, NCAR Satellite Remote Sensing Program, Whitepaper, NCAR, Nov. 2005.

Section 6:

A. Non-refereed publications (Presenting author only, last few years)

B. Seminars

1. *The Variability of Tropospheric Pollution: A Satellite Perspective*, NCAR, Boulder, CO, Mar. 9, 2007.
2. *The Variability of Tropospheric Pollution: A Satellite Perspective*, NOAA, Boulder, CO, May 23, 2007.

3. *Atmospheric Remote Sensing & Prediction*, NCAR, Boulder, CO, Oct. 31, 2007.
4. *The Satellite View of Southern Hemisphere Pollution*, University of Wollongong, Wollongong NSW, Australia, Feb. 21, 2008.
5. *Measuring Carbon Monoxide from Space*, University of Leicester, Leicester, UK, Dec. 12, 2008.
6. *Satellite Trace Gas Data & Assimilation*, ECMWF, Reading, UK, Apr. 26, 2009.
7. *Tropospheric Carbon Monoxide: A Satellite Perspective*, Jet Propulsion Lab., Pasadena CA, Nov. 17, 2009.
8. *Air Quality from Space: Defining Measurement Requirements*, Colorado State University, Fort Collins CO, Apr. 26, 2010.
9. *Satellite and ground-based remote sensing of carbon monoxide over Australasia: Linking global and local scales*, University of Wollongong, Wollongong NSW, Australia, Apr. 11, 2011.
10. *Observations of atmospheric composition from geostationary orbit*, NASA Langley Research Center, Hampton VA, Sep. 22, 2011.
11. *Observations of Atmospheric Composition from Geostationary Orbit*, ECMWF, Reading, UK, Jan. 27, 2012.
12. *The CHRONOS Mission*, Space Systems Loral, Palo Alto, CA, Feb. 29, 2012.
13. *Fundamentals of Atmospheric Composition Remote Sensing*, Yonsei University, Seoul, South Korea, Oct. 17, 2013.

C. Conference Presentations

1. *European Geophysical Union*, Vienna, Austria, Apr. 25–29, 2005.
2. *ESA Carbon from Space Workshop*, ESA/ESRIN Frascati, Italy, Jun. 6–8, 2005. [**Invited; Chair**]
3. *Workshop on the Global Tropospheric Carbon Monoxide*, Dubendorf, Switzerland, Oct. 24–26, 2005. [**Invited**]
4. *Workshop on Air Quality Remote Sensing From Space*, NCAR, Boulder CO, Feb. 21–23, 2006. [**Organizer; Chair**]
5. *Joint IGAC/CACGP/WMO Symposium: Atmospheric Chemistry at the Interfaces*, Cape Town, South Africa, Sept. 17–23, 2006. [**Co-Convener; Invited; Chair**]
6. *Joint TFHTAP & WMO Observations Workshop*, Geneva, Switzerland, Jan. 24–26, 2007.
7. *European Geophysical Union*, Vienna, Austria, Apr. 15–20, 2007.
8. *Workshop on Strengthening the Use of Earth Observations in Earth System Models*, Frascati, Italy, Sep. 12–13, 2007.
9. *Westar Fall Business Meeting*, Boulder CO, Sep. 18, 2007. [**Invited**]
10. *First IASI Science Conference*, Anglet, France, Nov. 13–16, 2007. [**Invited; Chair**]
11. *American Geophysical Union*, San Francisco CA, Dec. 10–14, 2007.

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12. *NASA OSSE Workshop*, Harvard University, Cambridge MA, Mar. 27, 2008.
 13. *Global Climate Change Technical Assessment*, Northrop Grumman Science and Technology, Los Angeles CA, Jun. 20, 2008. [**Invited**]
 14. *Journalism Fellowship Meeting*, NCAR, Boulder CO, Jun. 26, 2008. [**Invited**]
 15. *GEO-CAPE: Geostationary Coastal and Air Pollution Events Science Definition Planning Workshop*, University of North Carolina, Chapel Hill NC, Aug. 18–20, 2008. [**Invited; Co-Organizer**]
 16. *IGAC 10th International Conference, Bridging the scales in Atmospheric Chemistry: Local to Global*, Annecy, France, Sept. 7–12, 2008. [**Co-Convener**]
 17. *Community Meeting on Data Assimilation in WRF-Chem: Application to Chemical Weather Studies*, NCAR, Boulder CO, Jan. 6–7, 2009. [**Organizer; Chair**]
 18. *CISR Science Team Meeting*, John Hopkins University, Baltimore, MD, Feb. 17, 2009.
 19. *European Geophysical Union*, Vienna, Austria, Apr. 19–24, 2009. [**Invited**]
 20. *MOCA-09*, Montreal Canada, Jul. 19–29, 2009. [**Co-Convener**]
 21. *GEO-CAPE Science Working Group Meeting*, Columbia, MD, Sep. 22–24, 2009. [**Invited**]
 22. *NCAR EOL Retreat*, Lafayette CO, Oct 29–30, 2009. [**Invited**]
 23. *POGEQA Observing Air Quality from the Geostationary Orbit*, Toulouse, France, Nov. 4–6, 2009. [**Invited**]
 24. *American Geophysical Union*, San Francisco CA, Dec. 14–18, 2009
 25. *IASI Science Conference*, Annecy, France, Jan. 25–29, 2010. [**Co-Convener; Chair**]
 26. *GEO-CAPE Science Team meeting*, St. Petersburg FL, Mar. 24–26, 2010. [**Chair**]
 27. *European Geophysical Union*, Vienna, Austria, May 3–7, 2010.
 28. *IGAC/iCACGP, Atmospheric Chemistry: Challenging the Future*, Halifax, Canada, Jul. 11–16, 2010. [**Co-Convener**]
 29. *2010 EUMETSAT Meteorological Satellite Conference*, Cordoba, Spain, Sep. 20–24, 2010. [**Chair**]
 30. *4th IASI Sounding Science Team (ISSWG-2) Meeting*, ECMWF Reading, UK, Oct. 7–8, 2010.
 31. *POGEQA Observing Air Quality from the Geostationary Orbit*, Toulouse, France, Mar. 15–18 2011. [**Invited**]
 32. *34th International Symposium on Remote Sensing of Environment*, Sydney, Australia, Apr. 11–14, 2011. [**Invited**]
 33. *2nd GEO-CAPE Community Workshop*, NCAR, Boulder CO, May 11–13, 2011. [**Organizer, Chair**]
 34. *NASA Air Quality Applied Sciences Team (AQAST)*, NCAR, Boulder CO, May 14–15, 2011. [**Co-Organizer**]
 35. *2011 EUMETSAT Meteorological Satellite Conference*, Oslo, Norway, Sept. 5–9, 2011. [**Invited; Chair**]

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- 36. *American Geophysical Union*, San Francisco CA, Dec. 5–9, 2011.
 - 37. *Planet Under Pressure*, London, UK, Mar. 26–29, 2012.
 - 38. *POGEQA-3*, Toulouse, France, May 9–11, 2012. [**Invited**]
 - 39. *IGAC Atmospheric Chemistry in the Anthropocene*, Beijing, China, Sept. 17–21, 2012.
 - 40. *The 3rd GEMS Workshop*, Seoul, South Korea, Oct. 8–10, 2012. [**Invited**]
 - 41. *Atmospheric Composition Observation System Simulation Experiments (OSSE) Workshop*, ECMWF, Reading, UK, Oct. 22–24, 2012. [**Organizer; Chair**]
 - 42. *NASA Air Quality Applied Sciences Team 4th Meeting (AQAST 4)*, Cal/EPA HQ, Sacramento, CA, Nov. 29–30, 2012.
 - 43. *American Geophysical Union*, San Francisco CA, Dec. 3–7, 2012. [**Co-Convener; Invited; Chair**]
 - 44. *3rd IASI Conference*, Hyeres les Palmiers, France, Feb. 4–8, 2013. [**Co-Convener**]
 - 45. Middle East Air Quality Remote Sensing, Ball Aerospace and Technologies Corp., Boulder CO, Feb. 17, 2013. [**Invited**]
 - 46. *Colorado Wildfire Project*, Colorado Department of Public Health and Environment (CDPHE), Denver CO, Apr. 16, 2013.
 - 47. Committee on Earth Observation Satellites (CEOS) Atmospheric Composition Constellation Meeting (ACC-9), EUMETSAT, Darmstadt, Germany, 18–19 April 2013.
 - 48. 2013 GEO-CAPE Workshop, NASA Ames Research Center, Moffett Field, CA, May 21–22, 2013. [**Organizer; Invited; Chair**]
 - 49. Geostationary Ocean Color and Air Quality Coordination Meeting, NASA Ames Research Center, Moffett Field, CA, May 23, 2013. [**Organizer; Chair**]
 - 50. *POGEQA-4*, Toulouse, France, May 26–28, 2013. [**Invited**]
 - 51. *EVI-1 TEMPO Science Team Meeting*, Harvard-Smithsonian, Boston MA, Jul. 22–25, 2013. [**Invited**]
 - 52. *EUMETSAT Meteorological Satellite Conference*, Vienna, Austria, Sept. 16–20, 2013. [**Invited Keynote; Chair**]
 - 53. *The 4th GEMS Workshop*, Seoul, South Korea, Oct. 14–18, 2013. [**Invited**]